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INNOVATIVE STRATEGIES AND KNOW-HOW FLOWS IN INTERNATIONAL COMPANIES: SOME EVIDENCE FROM BELGIAN MANUFACTURING

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Abstract

Recent trends in the literature have suggested a change in the relative importance of the international dimension in the innovation process. International companies need to sense new market and technology trends worldwide, and respond to them adequately through generating new ideas which are then implemented around the world. This has important implications for the role of subsidiaries in global innovative strategies and consequent international know-how flows. This paper tries to empirically assess how technology flows are structured in international firms, using Belgian company data from the Eurostat Community Innovation Survey.

While all types of international firms, including subsidiaries, are found to be more innovation active than local firms, companies which are part of an international group, as affiliates but especially as headquarters, have the widest innovation strategy, relying on internal as well as external sources. These external sources are located nationally as well as internationally, and are accessed through buying and cooperative strategies. In addition, internal transfers and intra-group cooperation are quite pervasive in these companies, although the evidence for transfers from headquarters to subsidiaries is stronger than for the reverse flow from subsidiaries to headquarters.

The analysis further suggests the importance of reciprocity in know-how flows, through the importance of cooperative R&D agreements which relies on mutual exchange, and the complementary occurrence of selling and buying technology. An important implication for the host economy is that transfers to the local economy are more likely to come from subsidiaries that are integrated into the MNEs innovation process. Subsidiaries which are independent from the group's innovative process, are found to be less integrated with the local economy as well.

1. Introduction

With a global business environment where the pace and scope of changes in technological know-how and consumer taste are unprecendented, managing the innovative process has become more central in today's corporations. Innovation strategies require increasingly more global sourcing: sensing new market and technology trends worldwide, while adequately responding to them through generating new ideas which are then implemented around the world (o.a. Bartlett & Ghoshal (1997)). These tendencies imply a changing role of innovations in international companies, with important implications for the role of subsidiaries in recognizing the potential of innovations and exploiting them. Global sourcing and implementing innovations require finding an organisational structure that allows to effectively coordinate and link activities on a global scale, leading to important flows of know-how within and around MNEs.

This paper tries to empirically assess how technology flows are structured in international firms. Belgian company data from the Eurostat Community Innovation Survey are used, which allow to map national and international technology transfers and acquisition of know-how used by different types of companies such as subsidiaries of MNEs, headquarters of Belgian MNEs, Belgian exporting firms, or, local firms. Firstly, by analyzing the innovation strategies of different types of firms, the data allow to check to which extent trends towards truly global transnational technology sourcing have materialized in a small, but traditionally very open economy, such as Belgium. Secondly, we determine which modes of information sourcing are most effective to access know-how. At the same time, we distinguish the relative importance of international versus national information sources to the firms. Thirdly, we discuss the importance and directionality of internal technology transfers within MNEs. This allows us to classify subsidiaries according to the relative weight of technology transfers from headquarters to subsidiaries and from subsidiaries to headquarters. The autonomy to source externally, the importance of local external sources and the mechanisms used to transfer externally sourced know-how feature prominently in this classification of subsidiaries.

While all types of international firms, including subsidiaries are found to be innovation active, companies which are part of an international group, affiliates but especially headquarters, have the widest innovation strategy, relying on internal as well as external technology sources. These external sources are located nationally as well as internationally, and are accessed through buying strategies as well as cooperation. In addition, internal transfers and intra-group cooperation are quite pervasive in these companies, although the evidence for transfers from headquarters to subsidiaries is stronger

than for the reverse flow from subsidiaries to headquarters. The analysis further points at the importance of reciprocity in know-how flows, through the prevalence of cooperation which relies on mutual exchange. Nevertheless, foreign affiliates have a relatively lower frequency of cooperation with external partners that are located internationally. This indicates that, in line with the low strategic importance of the Belgian market, foreign affiliates that have a leading role in globally linked innovations are on average not (yet) pervasive for Belgium.

The outline of the paper is as follows. In the next section we briefly review the literature. Section 3 lays out the research agenda and discusses the data set. In Section 4 we present the main results of our analysis on the innovation strategy of manufacturing firms located in Belgium. Finally, Section 5 concludes.

2. Changing innovative strategies of transnational companies

In the traditional literature on multinationals, following the seminal work of Dunning (1988), multinational activities originate out of the R&D activities of the firm. To exploit the fruits from these intangible assets beyond the home market, rather than selling technology internationally through licensing, firms may prefer to set up or acquire affiliates in host markets. The latter mode allows the multinational to appropriate more benefits from its innovations, given the high transaction costs involved when transferring technology through market mechanisms. The result is internal transfers of know-how from headquarters to subsidiaries. This is the "*center-for-global*" innovations in the Bartlett & Ghoshal (1997) terminology, with emphasis on a centralized R&D function, based on centrally located generic knowledge.

The affiliative structure, with a direct geographic link between markets and production, leaves room for a role for the subsidiaries in incremental innovations: adjusting products and processes to (changing) local needs: the "*local-for-local*" types of innovations with a strongly decentralized R&D. Motives for R&D decentralization relate to market proximity where it is important to be close to "lead users" and adapt products and processes to local conditions. Supply related motives relate to the creation and renewal of core capabilities by allowing access to a wider range of scientific and technological skills. While adjusting products and processes to local specificities, subsidiaries create location specific knowledge, often through incremental innovations. These incremental innovations are generated in the local market and are associated with local knowledge flows.

Rather than seeing the geographic dispersion of MNEs as a result of knowledge creation, the emphasis in the literature has more recently shifted towards seeing the geographic dispersion of MNEs as a source for, rather than a result of, knowledge creation. Companies need to be responsive to market and technology opportunities and threats

worldwide, to generate innovations which are implemented on a global scale (Bartlett & Ghoshal (1997)). Since the pace and scope of technological and market change results in the increasing importance of external sources of technology, subsidiaries become important as vehicles to access (local) external sources. International R&D units are more and more engaged in cross-border interactions both across units within the MNE as between units and external partners (Westney (1997)). The subsidiary, using location specific know-how, can continually reassess and upgrade know-how on core products and technologies to provide a basis for new generations of innovative products used throughout the organisation, thus contributing to the generation of central generic knowledge. Bartlett & Ghoshal (1997) distinguish two possible innovative processes in this new view. In the *'locally leveraged'* innovations, the know-how generated in one subsidiary is transferred across the company to benefit other subsidiaries. Units are engaged in a world-wide learning from each other and therefore location specific knowledge must flow from one location to another. In the *'globally linked'* innovations resources and capabilities of all units are pooled within the MNE to jointly create innovations, which can be used by all units. This strategy builds on exploiting synergies from combining complementary know-how: central generic knowledge with location specific knowledge or location specific knowledge from multiple locations. In the Ronstadt (1977) terminology, these are the global technology units, while Pearce & Singh (1992) label these as the internationally interdependent labs, whose role is in the long-term basic research of the group, and who will have close collaboration with other similar labs.

Which role subsidiaries play in the innovative process of the MNE, depends on the level of technological capabilities and the strategic importance of the host market. On the one extreme, subsidiaries can play a purely implementing role for projects where they hold low levels of technological expertise and low strategic importance of the market. In this case the technology transfer is one of pure import into the local market. As soon as the location holds a high level of technological capability for a particular innovative project, it can be assigned a contributing role to develop generic central know-how or even play a more crucial leading role as 'center of excellence', with a 'global product mandate' (Rugman & Poynter (1982)); In those cases, the transfers of know-how are multiplex, with the subsidiary responsible for sourcing know-how in other units of the MNE (incl headquarters), but also accessing external sources. These third parties can be found in the local environment, if the technological capability of the subsidiary follows from being embedded in a "national innovation system", but third parties can be sourced across the globe.

In summary, the recent literature suggests a shift towards subsidiaries that are R&D active, not just in incremental, adaptive innovations, based on development activities, but

rather in drastic innovations, creating basic generic know-how, where the subsidiary is as active as headquarters in external linkages. Know-how needs to flow across units and locations. This requires working on effectively linking R&D units, mobility and transfer of people, building long distance interpersonnal communication and providing adequate reward systems and responsibilities (Westney (1997), Bartlett & Ghoshal(1997)).

Empirical evidence on know-how flows within multinational organisations has never been abundant. Recent studies can easily show the transfers of know-how from parents to affiliates, but find less conclusive support for the reverse direction, from subsidiaries to headquarters. Fors (1997) finds home R&D to significantly influence host output growth, while host R&D fails to influence significantly home output growth. Frost (1998), using USPTO data for 1980-1990, found evidence for the importance of headquarter patents for the innovations of subsidiaries. But patent data provided only limited evidence for the transfer of know-how from subsidiaries to headquarters. In addition, subsidiaries were using external sources, which were localized, i.e. proximity mattered a lot: patents from subsidiaries cited other entities located in the same state.

Case or survey based evidence confirms that MNEs are increasingly engaged in cross-functional learning from different sites [1] Pearce & Singh (1992) on an international sample find that although 44% of sample subsidiaries report that they predominantly function as internationally interdependent labs (IILs), on average 60% regularly worked to adapt to local markets. 70% developed new products for local markets, while 45% developed new products also used in other markets. The authors conclude that on average adapting is still an important task, but development of products also used in other markets is becoming more widespread (see also Pearce (1999)). They found little evidence that subsidiaries have a role in basic research through wider programmes. The "supervised freedom" granted to subsidiaries leads to less feedback back to the parent. The level of integration within the MNE of subsidiaries' innovative strategies often depends on historical factors, such as mergers & acquisitions, the type of industry (science versus market based), as well as home market characteristics such as size and technological competence (Niosi (1999)).

Changing innovative strategies will not only affect the internal know-how transfers within multinational firms, but also the flows of know-how to and from external sources. Traditionally, subsidiaries of MNEs are seen as vehicles for the international diffusion of technology, transferring know-how to the local economies. Mansfield & Romeo (1980)) found that two third of UK firms indicated that their technological capabilities were raised by

[1] For some recent studies, see the Research Policy Special Issue on the Internationalization of Industrial R&D, 1999, 2-3.

technology transfers from US firms to their overseas subsidiaries. But only 20% felt this effect was of importance. While MNEs may or may not generate positive spillovers on host economies, at the same time they extract know-how from the host economy. Evidence for technology sourcing as motive for FDI for Japanese companies investing in the US is provided by Kogut & Chang (1991), and for the US and Japan in the EC by Neven & Siotis (1996). Survey results for R&D labs located in the US, indicate the importance of access to human capital and technological expertise as major location motive (Serapio & Dalton (1993), Florida (1997)).

MNEs need not be present in the local market to access local sources. Technology is transferred through other channels than subsidiaries, such as licensing, purchase of equipment, international movement of personnel and other informal channels. Teece (1992) and Mowery (1992) stress that alliances can, in particular, be an effective and superior mechanism for linking external sources. Related to the question of whether a local presence through affiliates is necessary for know-how diffusion, is the question of whether spillovers are local or not. If networks are mainly informal and tacit, then embeddedness is important and spillovers will be localized. Jaffe et al. (1993) using patent data shows that proximity matters and that being close to an external source increases the impact of spillovers from that source on own know-how.

3. Research agenda and data

An increasing emphasis of international sourcing within international companies to successfully implement global innovative strategies, is profoundly influencing the pervasiness of technology flows, internally within international companies, but also externally between international companies and other relevant third parties in the local or global environment. This paper tries to empirically characterize how technology flows within and around different types of companies in a host economy. Figure 1 represents the different elements. A local firm in the host economy can be an independent (domestic) firm or can be part of an international group (MNE). If part of an international organization, the local firm, being an affiliate or a headquarter company, can receive transfer from other parts of the MNE, headquarters or affiliated companies. These affiliates or headquarters can be located in the same country or in different countries. At the same time the firm can transfer or sell technology to other parts of the international organisation. The firm can also access technology from external sources and transfer technology externally. All these transactions can be at the local or international level. Although the affiliated companies can also source and transfer technology to an international or national external source, these flows are not studied here because of lack of information.

[INSERT FIGURE 1]

The paper tries to address whether firms with different international strategies (local firms, exporting firms, headquarters and subsidiaries of MNEs) have different innovation strategies? For each type of firm, the following patterns are examined and compared:

- What are the important technology sources for innovation ?
  - Are they internal or external? Are they national or international?
- Is technology transferred?
  - Are these transactions internal or external? national or international?

Such analysis allows to consider a.o. whether subsidiaries of MNEs get their technology inputs from headquarters? From local external sources? From global external sources? Whether subsidiaries transfer their know-how to headquarters or other parts of the company? From which type of firm the local economy is more likely to benefit: subsidiaries, headquarters, or, exporting firms? Comparing MNEs with exporters allows to assess whether the mode of internationalisation has an impact on know-how flows. Comparing headquarters and subsidiaries allows to study the impact on the local economy simultaneously as a host as well as a home to international firms.

The analysis draws on innovation data for the Belgian manufacturing industry that were collected as part of the Community Innovation Survey conducted by Eurostat in the different member countries in 1993. The survey intended to develop insights into the problems of technological innovation in the manufacturing industry and was the first of its kind organized in many of the participating countries. A representative sample of 1335 Belgian manufacturing firms was selected and the 13-page questionnaire sent out to them. The response rate was higher than 50% (748). The researchers in charge of collecting the data also performed a limited non-response analysis and concluded that no systematic biases could be detected (Debackere & Fleurent (1995)).

The survey allowed to identify companies based on their size and innovativeness, but also on their international linkages: their export-intensity, whether they belonged to an international group, with foreign or local headquarters. It contained, next to questions on motives and problems of innovations, questions on the importance of internal and external information sources for innovation, the use of different mechanisms to acquire technology (nationally and internationally), the use of different mechanisms to transfer technology (nationally and internationally), and the use of cooperation in R&D with different types of partners (nationally and internationally). As such the data allow us to characterize a firm's

innovative strategy based on the following decisions: the technology make or buy decision, the technology sell decision and the decision to cooperate in R&D. In view of the reciprocity that lies at the basis of most cooperative agreements, we take cooperation to be a simultaneous buy and sell transaction.

While this study uses direct survey evidence on the occurrence of technology acquisition and transfers, it provides less evidence on the size of these flows and their impact on other economic variables and hence, may be critized for subjectivity. To the best of our knowledge, the only alternative attempt to trace know-how flows *within* and *across* firm boundaries, is the use of patent information, more particularly an analysis of citations to previous patents, see e.g. Frost (1998) for the USPTO data. However, with a vast amount of information transferred without writing it down in patent applications or even in formal contracts, we consider resorting to more qualitative data like the EUROSTAT/CIS data as an important source of information on firms' innovation strategy.

4. Results

Section 4.1. presents a classification of international strategies. Section 4.2 discusses for each type of international firm, innovative strategies in terms of make, buy, sell and cooperate. The national versus international dimensions of technology flows through buy, sell and cooperate are detailed in section 4.3. Section 4.4 presents a typology of foreign subsidiaries on the basis of transfers to and from affiliated firms.

4.1 A characterization of the sample

The companies in the sample could be identified along their international involvement:

- SUB when the company is a subsidiary of an international group. Within this classification we will make a distinction between FSUB which are subsidiaries with foreign headquarters, and BSUB which are subsidiaries of an international group with Belgian headquarters. [2]
- HQ when the company is the headquarters of an international group. Given our sample this means that the headquarters are located in Belgium.
- EXP when the company is independent or part of a Belgian group without foreign affiliates, but exporting more than 50% of their production abroad.
- LOC when the company is independent or part of a Belgian group without foreign affiliates, and exporting less than 50% of their production abroad.

[2] Incorporating BSUB with their HQ group did not significantly alter the results of the analysis.

With 44% of the total number of companies being local, the sample displays a dichotomy in international scope. 32% of the sample companies are subsidiaries, most of which are foreign (28%) and 4% of the sample companies are in the HQ category. One fifth of the companies have an exporting profile (EXP).[3] This distribution is very typical for a small and open economy such as Belgium, with little own multinationals but a pervasiveness of foreign affiliates and exporting firms. With respect to the industry distribution, local firms are overrepresented in food, textiles, wood and paper and other industries, but underreprestented in chemicals and electronics. Foreign subsidiaries on the other hand are overrepresented in these sectors. Headquarters and Belgian subsidiaries are mainly found in chemicals and (non-ferrous) metals and textiles.

Size is strongly and significantly correlated with the degree of international involvement. 75% of local companies have less then 50 employees. With almost two third in the category of >250 employees, headquarters and subsidiaries are overrepresented in the largest size category. The majority of exporting companies (53%) are found in the mid-sized category, between 50 and 500 employees.[4]

In line with the industry distribution and size correlation, an international strategy is also strongly associated with innovation. While 48% of local companies are innovative (i.e. claimed to have introduced new or improved products and processes between 1990-1992 and reported a budget for innovation), for exporting firms competing in international markets this percentage is 72%. Members of an international group are even more innovative: all headquarter-type firms are innovative, while 85% of subsidiaries are innovative. This last number indicates that innovation appears as an important subsidiary level function, although the percentage is smaller than the, in size comparable, headquarter type of companies. It furthermore remains to be investigated whether this innovation derives from implementing existing centralized know-how, or relies on locally generated know-how, a topic that will be analyzed in the next section. In the remainder, the sample will be restricted to innovative companies only, since the survey only provides information on knowledge flows for this subsample.[5]

4.2. Innovative strategy by the degree of international involvement

A firm can rely on a combination of different strategies to manage its innovation process and engage in innovation. We will distinguish between knowledge inputs into the innovation process and knowledge outputs from the innovation process. With respect to knowledge

[3] Note that also the HQ and the SUB category typically have a high export-intensity.
[4] To compare, for the total sample, 43% is in the <50 category, 24% in the 50-250, 16% in the 250-500 and 17% in the >500 category.

inputs, we analyze two sources. First, firms can do R&D in-house and develop their own technology, which we label as the firm's MAKE decision. A second alternative strategy is to acquire technology externally, the BUY decision. Within the BUY decision a firm can acquire new technology which is *embodied* in an asset that is acquired such as new personnel or (parts of) other firms or equipment. Alternatively new technology can also be obtained *disembodied* such as in blue prints through a licensing agreement or by outsourcing the technology from an R&D contractor or consulting agency. While buying allows access to more specialized resources, it introduces market transaction costs. Another knowledge sourcing strategy is to absorb existing technology without any explicit involvement from the innovator. Freely available information or involuntary spillovers from innovators can be used by companies in their innovation process.

As part of its innovation strategy, the firm also decides on knowledge outputs through the transfer and sale of knowledge or technology to interested parties. Given the importance of information flows towards an economy, we will also analyze this part of the innovation strategy for the different types of firms.

A more hybrid form of obtaining knowledge and developing new technology is through cooperative agreements between firms or other research institutions. As compared to market transactions and internal development, cooperation allows a faster, less costly and lower risk mode of accessing new technology, while exploiting partner complementarity and actively managing the transfers of know-how between partners (Pisano (1990)). The inherent reciprocity, which can be considered a simultaneous technology sell transaction, allows to manage the risks of partner opportunism, reducing transaction costs (Oxley (1997)). We will thus consider an innovation strategy that includes cooperation as evidence of simultaneous buy and sell activities of the firm (see Teece (1992) and Mowery (1992)).

4.2.1. Innovation Strategy: Make, Buy, Sell and Cooperate

With the exception of the strategy of capitalizing on involuntary spillovers, the different sourcing strategies could be empirically identified. Given the lack of available data at the project level, the make, buy, sell and cooperate decisions are studied at the firm level. Identification of the presence of an innovation strategy and whether this innovation strategy includes make, buy, sell or cooperate, is based only on whether these strategies have been used or not. Information on budgets was incomplete and unreliable. Table 1 presents the results.

[INSERT TABLE 1]

[5] Of the total 494 innovative companies, 32% are LOC, 21% is EXP, while 6% is HQ and 41% is SUB (35% FSUB and 6% BSUB).

At the firm level, innovative companies typically combine internal and external sources of innovation, witness the high percentage of companies making technology (80%), as well as the high percentage of firms buying technology (74%). All firms that are cooperating in R&D, also have own R&D activities.

Compared to local firms, all types of international firms have a significantly higher probability of having own R&D activities, especially firms belonging to international groups (HQ and SUB). These latter firms are also significantly more active in acquiring and selling technology as well as in R&D cooperation. Exporting companies are relatively less engaged in acquiring and selling technology, as well as in cooperative agreements, in comparison to subsidiaries and headquarters. Although a majority of innovative local companies have own R&D activities, they are in comparison to international firms relatively more relying exclusively on externally acquired technology.

Hence, in comparison to local and exporting companies, being part of an international group is most associated with combining internal and external sources for innovation. When buying technology, both disembodied and embodied technology acquisition is pursued. Embodied purchase is mainly through personnel. Interesting to note is that subsidiaries are most active in disembodied purchase of technology and relatively less through embodied purchase, as compared to headquarters. With acquisition of technology so pervasive among companies which belong to international groups, it remains to be investigated whether this external sourcing is local or global, a topic discussed in section 4.3. But it is already important to note that 47% of the technology acquisition by headquarters is internal acquisition within the group, while for subsidiaries this is 56%.

In order to start understanding whether Belgium gains from its openness, the other side on the transaction market should be considered as well, namely the supply of know-how. The table shows that 44% of all innovative companies in the sample are engaged in selling know-how. This number is considerably lower than the number of companies acquiring know-how, but varies for the different types of companies. While the lowest numbers are for innovative companies which are local or exporting, 83% of headquarters are involved in selling know-how. Subsidiaries, although comparable in size, are significantly less involved in selling technology, be it that more than half of them are engaging in know-how sales. For companies belonging to an international group, intra-company transactions are quite pervasive: 90% of headquarters sell technology to affiliated companies, while this percentage is 60% for the opposite transaction, when subsidiaries sell to other group members. This is consistent with *central-for-global* or *local-for-local* innovation strategy, where the headquarters are more active in supplying the subsidiaries with technological expertise, rather than the subsidiaries increasing the knowledge pool at the central R&D lab.

Selling technology is complementary to buying technology: 40% of all innovative companies buy and sell technology at the same time. Both buying and selling technology at the same time is much less obvious for local and exporting firms, typically only one quarter combine buying and selling technology. This percentage is much higher for headquarters and subsidiaries (resp 80% and 54%). The complementarity in buying and selling technology is also apparent in the higher frequency of cooperation for headquarter or subsidiary firms. More than 60% of these companies have at least one cooperative agreement.

4.2.2 Importance of external sources

While the analysis thusfar has detailed how international companies are actively accessing external sources, it remains to be examined how important these sources are in the innovative process of these companies. The CIS survey data allow to assess the importance of internal and external sources of technological information for innovative companies. The respondents were asked to rate the importance to their innovation strategy of different information sources for the innovation process on a 5-point Likert scale (from unimportant (1) to crucial (5)). In order to manage the answers on these many questions, we aggregated the answers by averaging the scores on related variables. Table 2 summarizes the different categories.

[INSERT TABLE 2]

The percentage of companies rating the various sources as very important to crucial (i.e. a score of 4 or 5) is reported in Table 3 for the various international categories.

[INSERT TABLE 3]

Sources internal to the company (INTERN) are in all cases most important for innovation. Especially the headquarters score high on this item. Subsidiaries, given their comparable size, rate this source less importantly as compared to headquarters, although it is still their most important technology information source. For subsidiaries, sources internal to the group (INTGR) are very important. This source is ranked secondly, which is not the case for the other companies. In particular, headquarters find suppliers and customers more important as an information source. These results are again consistent with the *central-for-global* innovation strategy of MNEs and corresponds to the results of Pearce & Singh (1992), who also found 77% of subsidiaries to indicate own ideas, approved by the parent to be a regular source of project ideas. Only 13% indicated suggestions from parent labs as regular source, but 70% rated them as occasional source.

Among external information sources, especially the vertically related customers and suppliers are important sources of information. For all types, this is the most important

external source, followed by competitors. Interesting to note is the low importance of research institutes; with only 4% rating them to be very important or crucial. Although this source is not crucial, it is still on average moderately important. [6] A sectoral differentiation is typical here, depending on the science based nature of the technology used.

One mechanism through which external sources may be accessed are cooperative agreements. As reported in Table 4, disentangling different types of cooperative partners for the various firm-types confirms the importance of inter-group cooperation for headquarters and subsidiaries, confirming that cooperative agreements perform an important knowledge transfer function. For subsidiaries, this is the most important type of cooperative agreements. Similarly we observe that vertically linked companies are most important as external partners for the other firm types. Somewhat unexpected, research institutes are important cooperative partners, especially for the headquarter firms. All this suggest that research institutes cannot be neglected as external source, but that on average they tend to be only moderately important to the innovativeness of companies.

[INSERT TABLE 4]

In summary, although internal and external information sources are important to subsidiaries, their higher share of within-group sources and their lower share of within company and external sources in comparison to headquarters, suggest that the role of subsidiaries in generating global innovations is on average for the Belgian economy not pervasive. Along with Frost (1998) and Pearce & Singh (1992), these results support the importance of headquarters for subsidiaries, while the evidence of transfer of know-how from subsidiaries to headquarters is more limited, witness the lesser importance of within-group sourcing for the HQ-type. The lesser importance of science as source of information indicates that, on average, the Belgian science system does not seem be a crucial location factor for subsidiaries.

4.3 National versus International Innovation Strategies

Given that information exchanges are such an important element in the innovation strategy of firms, especially for the internationally involved companies, it remains to be investigated whether these exchanges are national or international. At the same time, this should reveal the directionality of these information flows for internationally active companies. In addition, policy makers attempt to maximize the knowledge in-flows to the local economy. We are in a position to analyze which parts of the innovation strategy and which type of firm is more likely to generate these kinds of information flows.

[6] The % of companies rating this source at least moderately important (i.e. a score of at least 3) is on average 25%, but for headquarters, this percentage increases to 50%.

4.3.1 National versus International Technology Acquisition

When buying technology, both national and international sources are used, be it that international transactions are used more than national transactions. Table 5 presents the results. On average 57% of companies buy technology internationally, and 53% buy nationally. For local companies and exporting companies, the prevalence of national overrules the international transactions. Interesting to note is the position of subsidiaries. For every foreign affiliate who buys technology nationally, there are 1.5 foreign affiliates that buy technology internationally, the highest ratio among all types of companies.

[INSERT TABLE 5]

Disentangling disembodied and embodied acquisition of technology is important, since the embodied acquisition is typically hypothesized to be more localized than the disembodied purchase. The results support this hypothesis. International disembodied transactions are more used than national disembodied transactions. Only for local companies does the prevalence of national transactions in disembodied acquisition slightly overrule the international transactions. Interesting to note is the position of subsidiaries, who have the strongest international orientation in disembodied buying of technology. Contrary to the profile of disembodied purchase, there are more companies that buy embodied technology nationally (35%) than internationally (20%). The national orientation is again highest for the local companies. Only for foreign subsidiaries, there are more companies that acquire technology embodied internationally than nationally. [7]

In conclusion, although a majority of companies are acquiring technology nationally, the local embeddedness should not be overrated, since international technology acquisition is even more prevailing, especially disembodied technology acquisition through licensing. Only the embodied acquisition through personnel has clearly a more national orientation. The international orientation of external sourcing is less pronounced for the local companies, but most pronounced for the headquarters and subsidiaries of foreign companies. For the case of foreign subsidiaries this result puts in perspective the importance of local external technology sourcing as motive for a foreign presence through embedded affiliates in Belgium. The high percentage of international technology acquisition for headquarters suggests that having own affiliates abroad is conductive to acquiring technology internationally. Exporting firms do not appear to be more successful at acquiring technology

[7] The national-international ratio can be further detailed for the different modes of embodied and disembodied purchase. Most internationally oriented are licencing. R&D contracting is nationally as important as internationally. Only for foreign subsidiaries are there more companies outsourcing internationally than nationally. For embodied purchase of technology, the national orientation is solely due to the item personnel. For buying equipment and take-overs, international is more important than national. Hence, know-how acquisition through personnel mobility is the most localized

internationally compared to local firms. This puts doubt on exporting as an effective mechanism for knowledge acquisition.

To better understand the role of international technology acquisition in the innovative strategies of affiliates, it is important to assess the extent to which these international flows are received from within the company, typically from the headquarters, or are truly external, originating from third parties. For companies belonging to an international group, the survey data allow to assess whether national and international acquisition is internal to the group or not. 42% of headquarters that acquired technology internationally reported internal acquisitions within the group, i.e. transfers from subsidiaries to headquarters. This indicates the importance of headquarters in sourcing technology through its foreign subsidiaries according to a '*locally leveraged*' or '*globally linked*' innovation strategy.[8] 66% of foreign affiliates located in Belgium and acquiring technology from abroad, indicated international internal transfers within the group, from sister or typically parent companies. The higher percentage of internal acquisition for subsidiaries compared to headquarters underscores, in line with Frost (1998), the importance of headquarters or other leading sister companies as source for innovation within subsidiaries located in Belgium. While there is strong evidence for substantial internal transfers, the direction is most from headquarters to subsidiaries.

4.3.2 National versus International Technology Sale

While the evidence on the selling of technology, presented in section 4.2.1 indicates the importance of MNEs as vehicles for technology diffusion, it remains to be investigated whether these transfers occur nationally in the host market or internationally.

[INSERT TABLE 6]

Table 6 shows that transactions of technology that remain in the local market are relatively less frequent: only 17% of innovative companies have transferred technology locally, versus 39% of innovative companies selling internationally.[9] The majority of transactions by innovative companies in the Belgian sample are international transactions, mostly disembodied While there are about as many local companies selling technology nationally as well as internationally, the international orientation of transactions is highest for the headquarters. Also for foreign subsidiaries, the international orientation is more pronounced. In contrast to the embodied acquisition of know-how which was most localized,

[8] None of the national acquisitions made by foreign affiliates are internal within the group. For Belgian headquarter companies, internal within group transactions only constitute a limited 5% of national acquisitions made by these companies. For Belgian subsidiaries this is 31%, indicating important transfers from the headquarters, which happen to be located in Belgium.

the embodied transfer of know-how is strongly international: for every company transferring know-how embodied nationally there are 2.7 companies transferring know-how embodied internationally, an effect which is due to the Belgian MNEs and foreign subsidiaries. This result suggests a strong international mobility of the Belgian workforce employed within these firms. [10]

Given this strong prevalence of international know-how flows in international groups, it is interesting to check whether these transfers remain within the group. 91% of headquarters that transfer technology internationally report internal international transfers, while this is 81% for foreign subsidiaries and 85% for Belgian subsidiaries. These high numbers again reflect the importance of internal transfers crossing national boundaries within MNEs and reflect that MNEs are an important channel for international technology diffusion. We find that Belgian subsidiaries play an important role for foreign sister companies, consistent with the '*globally linked*' innovation strategy.

To conclude, the embodied and disembodied transfer of know-how to the local economy is quite restricted. As we discuss next, the international focus in buying and selling strategies contrasts with the more national focus observed in technological cooperation. The hope is that such cooperation is an effective mode to transfer know-how to the local economy.

4.3.3 National versus International Cooperation

Although the evidence for local embeddness in technology sourcing so far is not very strong for foreign subsidiaries, there are other modes through which companies can access externally available know-how. Cooperating in R&D can be used to source as well as transfer technology externally. Section 4.2.1 already indicated that cooperation is quite pervasive among innovative companies, especially for those companies belonging to an international group. The survey allows to check whether partners in cooperation are national or international, as well as affilated companies or independent third parties.

Table 7 reveals that most companies, especially those belonging to an international group, combine national and international cooperation, be it that more companies are engaged in cooperation with national partners than with international partners. For local companies the national orientation is somewhat higher, and for HQ this is somewhat smaller, but these differences are not significant. It is interesting to note that headquarters tend to be

[9] Note the significantly higher local technology transfer by Belgian subsidiaries. 74% of these subsidiaries are however transferring technology internally, most likely to their headquarters.

[10] Detailing the channels which are used most often to transfer know-how, we find that for international transactions, consulting is used most often, followed by personnel, informal contacts, licenses and R&D contracts. Of little importance is selling of companies and selling of equipment to transfer technology. For national transactions, personnel, consulting and informal contacts are most often used. There are no significant differences in the relative importance of these channels according to the type of firm.

more engaged in cooperative agreements than subsidiaries. Given their technology transfer function, we find this difference to be more important internationally.

[INSERT TABLE 7]

The type of partner differs between national and international cooperative agreements in R&D. The national orientation of alliances is highest for vertical alliances. On the one hand, this indicates that proximity might be more important to benefit from a cooperative agreement with suppliers or customers. On the other hand, this might just be the result of the availability of partners. The national orientation of alliances is lowest for research, leaving the largest category of external partners for international alliances to be research institutes.

Although more than one third of innovation active foreign affiliates have vertical alliances with national partners, it is the type of company that has the lowest share of local vertical partners in national cooperation. Similarly for national cooperation with research institutes, foreign affiliates have the lowest share of local research partners in national cooperation. So again we find little evidence for MNEs using foreign affiliates to access the local science system in Belgium. For companies belonging to an international group, cooperation with affiliate firms is quite pervasive. For the foreign subsidiaries, affiliated companies are the most frequent partner, especially in international cooperation, reflecting that these subsidiaries have a function in locally leveraged or globally linked innovations. This is also the case for headquarters that transfer technology to their international affiliates through cooperative agreements.

In summary, headquarters and Belgian subsidiaries are as active in national as in international alliances and this with several different types of partners: vertically related firms, research institutes and affiliates of the same international group. Foreign affiliates are also active in alliances, even somewhat more in national than international alliances, but the scope of their different type of partners is more restricted, with a larger share of affiliated companies. All this seems to suggest that for foreign affiliates located in Belgium the emphasis is more on a "contributing" role in the global innovative strategy of their parent, with specific tasks for globally linked innovation projects, but less of a "leading" role on average, because this would involve more cooperation with third parties, nationally and internationally. The absense of a leading role corresponds to the low strategic importance of the local Belgian market. Export oriented companies are least cooperative (only 38% have cooperative agreements), with the strongest national orientation. All this suggests that exports is not the most straightforward internationalisation mode that is conductive towards international cooperation, as it also was not for buying technology.

4.4 A typology of Foreign Subsidiaries

The analysis so far has compared companies that differ in their international strategy: locals and exporting firms versus headquarters and affiliates. As the theoretical literature strongly suggests, the large group of foreign affiliates cannot be treated as one homogeneous block, when describing their innovative activities. Zeroing in on the foreign subsidiaries only, the information available in the survey on internal transfers of information within multinational groups, allows to classify foreign subsidiaries according to their role in the MNE's innovative strategies. Once subsidiaries have been identified according to this role, the classification can then be used to look for possible differences in innovative strategies with regard to buying and selling know-how and cooperating in R&D. Especially any difference in the local orientation when buying and selling know-how can be helpful to assess which types of foreign subsidiaries are attractive for the host economy.

Figure 2 shows that of the 208 subsidiaries present in the sample, there are 23% which are not innovative active (17%) or which are innovative active but have no own R&D, i.e. rely exclusively on buying (6%). For these companies we have no information on transfers received. Compared to the total sample, this is a relatively low percentage, suggesting that affiliates are most likely to have their own innovative capacities. The 160 subsidiaries that have an own R&D capacity (MAKE), can be classified according to whether or not they receive know-how from within the group and/or whether they generate transfers of know-how to the group. Companies are classified on "Transfers received from affilates" as YES when they report that from the know-how they received, internal within-group sources were accessed AND when these internal group sources were at least moderately important to the innovative process of the subsidiary[11]. For the variable "Transfers generated to affiliates" only information on the occurrence of such transfers was available, not on the importance of these transfers.

[INSERT FIGURE 2]

About 31% of foreign subsidiaries receive no transfers and also generate no transfers to the group. These are labelled as *independent* or autonomous subsidiaries. These affiliates, quite important in number, may be older, longer established subsidiaries that traditionally have build up an independent 'local for local' innovative strategy. Apparently, their parents, when implementing a truly global innovative strategy, still have an important task to integrate the local know-how process in the central know-how process. Only 9% of foreign subsidiaries receive internal transfers, but do not generate any internal transfers. These are

[11] When using as criterion for importance of internal group sources at least very important, especially a considerable number of integrated subsidiaries shift to the sourcing category, leaving 33% sourcers and 26% integrated companies.

the typical *adapting* subsidiaries, implementing 'central for global' innovations while adjusting them to the local market. This low number does not suggest that adapting is not important, but that it is less important as the main innovative activity of affiliates. Subsidiaries that have a role as sensors, scanning technological developments to direct global innovations, receive no internal transfers, but generate transfers to affiliated companies. These *sourcing* subsidiaries account for 20% in the sample. The largest group of affiliates is the one that simultaneously receives and generates internal know-how transfers: 39% of foreign affiliates are thus labelled as *integrated*. The two-way internal flows in which they are engaged could indicate a leading role in 'locally leveraged' or even 'globally linked' innovations, but also a contributing role, with specific tasks in 'globally linked' innovations could fit into this characterization.[12]

Another important mode through which transfers of know-how can materialize are cooperative agreements among affiliated companies. Consistent with the classification, one would expect independent subsidiaries to be the least engaged in such alliances and the integrated subsidiaries the most. Also for sourcing and adapting subsidiaries such alliances can be an integral part of their innovative strategy, be it that the intensity of know-how flows between partners need not be equal in all directions. As expected, the independent subsidiaries are significantly less likely to be engaged in such alliances as compared to the other affiliates. Only 34% of them have intra-firm alliances, as compared to 47% for all subsidiaries.

Having classified subsidiaries according to their role in global innovations, it remains to be analysed whether different types of subsidiaries use different innovative strategies. At the same time the national versus international dimension in external technology buying, selling and cooperating, may differ. Table 8 presents these results.

[INSERT TABLE 8]

Not surprisingly, the sourcing and integrated affiliates have the highest frequency of locally buying technology. Similarly the integrated affiliates also have the highest frequency of alliances with local external partners. Although more than half of the sourcing affiliates have alliances with local partners, this is not as high as expected, compared to the other types of subsidiaries. The independent and adapting affiliates are less actively engaged in accessing external local know-how: the independent affiliates are particularly underutilizing cooperation with local partners, while the adapting affiliates are particularly less involved in the buying of

[12] For the Belgian subsidiaries, we find that 74% are engaged in transfers to affiliates, compared to 59% of foreign subsidiaries, explained by their proximity to headquarters: only 19% of the Belgian subsidiaries are classified as independent and 7% as adapting, but 48% are sourcing and 26% integrated.

local technology. The independent subsidiaries seem to be not only independent from their group, but also independent from external sources in general.

Cooperation with external partners located internationally reflects a discretionary power to scan worldwide for partners that are most complementary. Not surprisingly then, the integrated affiliates have the highest propensity to be engaged in such alliances, and the independent the least. The international buying variabele cannot disentangle internal and external transactions. As such, the score for adapting and integrated affiliates is high by definition, already based on internal transactions. But interesting to note is the high frequency of international buying for sourcing companies. Since by definition, these are not internal transactions, this results suggests that the market which these subsidiaries are supposed to scan extends the Belgian market to include a wider, European, market. The international cooperative agreements of these companies should be likewise interpreted. Not surprisingly, the independent affiliates have the lowest frequency of internationally buying technology. Still, 56% of them have acquired technology from an external partner, which is internationally located.

An important question from a policy point of view is to find out which type of subsidiary is most attractive for the host economy in terms of being able to absorb most know-how from. The integrated and the sourcing affiliates have the highest propensity to sell to local partners. In combination with the high frequency of allying with local partners, these companies constitute a serious source of accessible know-how for the local economy. The adapting and especially the independent subsidiaries are the least engaged in local transfer of technology. The independent subsidiaries, for which this lack of local selling comes on top of the low propensity to ally locally, are therefore the least interesting for the local economy in terms of transfers of know-how.

5. Conclusions

The EUROSTAT/CIS survey results for Belgium clearly indicate that internationally operating firms are more innovation-active. But while all types of international firms, including subsidiaries are found to be more innovation active, companies which are part of an international group, as affiliates but especially as headquarter, have the widest innovation strategy, relying on internal as well as external technology sources. Internal within-group transfers and intra-group cooperation are quite pervasive in these companies. In addition, they access not only local but also international external technology sources, through buying strategies as well as cooperative R&D agreements. While disembodied purchase of know-how (licensing) is most international, the embodied purchase of know-how through personnel mobility is most localized. Also for R&D contracting and R&D cooperation the

local orientation is stronger. Hence, having a presence in the foreign market is more conductive to accessing foreign know-how through these mechanisms.

The evidence on the difference between headquarters and affiliates in their frequency of internal international buy and sell, and the importance of intra-group sourcing suggests, in line with previous studies, that transfers from headquarters to subsidiaries are more frequent and important than compared to the reverse flow from subsidiaries to headquarters.

The analysis further suggests an important role for reciprocity in know-how flows, through the prevalence of cooperation which relies on mutual exchange. In addition, there is a strong complementarity between selling and buying technology. Interestingly those firms receiving know-how are also more likely to transfer know-how. In a companion paper, Cassiman & Veugelers (1999) show how companies that have access to international technology markets, either by directly buying technology internationally or through international cooperative agreements, are more likely to transfer know-how nationally through the direct sale of technology, but in particular through national cooperative agreements. This holds especially for the headquarters and subsidiaries. But the results presented here also strongly suggest a complementarity between technology transfers occurring internally within the MNE and transfers to the local economy. Foreign affiliates which are receiving internal know-how, when they are integrated in the multinational innovative process, are more likely to generate local transfers and to cooperate with local partners. Those affiliates that are operating most independent from their multinational structure are least likely to transfer know-how locally or to cooperate locally. This result suggests that a trend towards having subsidiaries playing a more integrative role in the multinational innovations is not necessarily detrimental for the host economy, at least in terms of being able to benefit from the spillovers of this know-how.

Although most of these results are confirmed in econometric analysis, correcting for firm and industry characteristics, (see Cassiman & Veugelers (1999)), more work is needed to test the robustness of these results, before the results can be moulded into firm conclusions for MNE's innovative strategies and host government's innovative policy. The Eurostat data allow us to compare results across EC countries. This would allow to identify possible host markets characteristics which the literature suggests, influence the results. More importantly, the analysis should be extended beyond whether know-how flows occur or not, towards assessing the efficiency of such flows, and their impact on innovative performance and growth.

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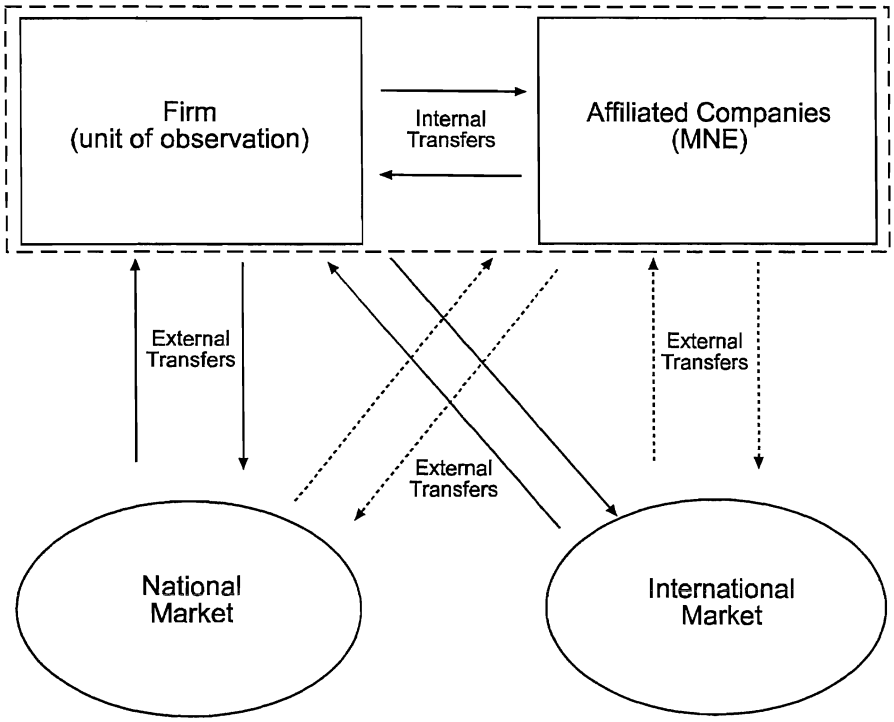


Figure 1: National and International Technology Flows

Table 1: Innovation Strategies of Belgian Manufacturing Firms					
	TOTAL	**LOC**	**EXP**	**HQ**	**SUB**
N	*494 (100%)*	*158 (32%)*	*104 (21%)*	*30 (6%)*	*202 (41%)*
MAKE	**80%**	**61%**	**81%**	**100%**	**93%**
BUY	**74%**	**67%**	**65%**	**90%**	**81%**
DEMB	65%	55%	50%	87%	77%
EMB	44%	46%	39%	57%	43%
SELL	**44%**	**27%**	**29%**	**83%**	**59%**
DEMB	42%	24%	27%	80%	58%
EMB	26%	15%	13%	53%	38%
COOP	**44%**	**22%**	**38%**	**67%**	**61%**

- MAKE= innovative companies that have own R&D activities and have a positive R&D budget.
- BUY= innovative firms acquiring technology through licensing and/or through R&D contracting and/or through consultancy services (DEMB) and/or purchase of another enterprise and/or hiring skilled employees (EMB). We disregarded the "embodied" purchase of equipment, mainly because too many firms responded positively on this item. The reported results are not affected by the inclusion or not of purchase of equipment in the buy option. Probably not all of them interpreted the question as buying equipment with the explicit purpose of obtaining new technologies and as an alternative to developing the technology internally (see also Evangelista et al, 1997).
- SELL= innovative firms selling technology through licensing and/or through R&D contracting and/or through consultancy services (DEMB) and/or purchase of another enterprise and/or hiring skilled employees (EMB).
- COOP=innovative firms that have cooperation in R&D, where both parties have an active involvement.

TABLE 2: Sources of Information for the Innovation Process	
Internal Information Sources: INTERN	information within the company
Internal Information Sources: INTGR	information within the group
External Information Sources • From Vertically Related Firms: LINK	information from suppliers information from equipment suppliers information from customers
• From competitors: COMP	Information from close competitors
• From Research Institutes: SCIENCE	Information from Universities Information from Public Research Institutes Information from Technical Institutes
• Freely Available Information: GINFO	patent information specialized conferences, meetings, publications trade conferences, seminars

TABLE 3: Importance of Information Sources for the Innovation Process[1]					
	TOTAL	**LOC**	**EXP**	**HQ**	**SUB**
INTERN	72%	62%	69%	87%	79%
INTGR	36%	17%[2]	25%[2]	37%	57%
LINK	45%	40%	49%	60%	45%
COMP	33%	30%	26%	47%	36%
SCIENCE	4%	4%	1%	0%	5%
GINFO	17%	12%	10%	33%	23%

[1]The percentage of companies rating the various sources as very important to crucial (i.e. a score of 4 or 5).
[2]Only very few local and exporting firms are part of a group. The average score of INTGR for these types is therefore not very revealing

TABLE 4: Cooperative Agreements by Type of Partner[1]					
	TOTAL	**LOC**	**EXP**	**HQ**	**SUB**
%COOPLink	28%	13%	25%	50%	38%
%COOPComp	7%	3%	9%	13%	8%
%COOPScienc	28%	12%	23%	57%	39%
% COOPIntgr	24%	2%[2]	4%[2]	53%	47%

[1]**COOPLink**: at least one cooperative agreement with suppliers or customers, **COOPComp**: at least one cooperative agreement with competitors, **COOPScienc**: at least one cooperative agreement with universities, public or private research institutes, **COOPIntgr**: at least one cooperative agreement within the group.
[2]Only very few local and exporting firms are part of a group. The average score for these types is therefore not very relevant

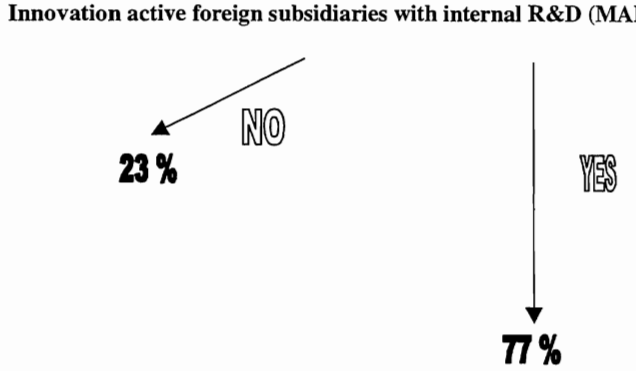
TABLE 5: National and International Technology Acquisition						
	TOTAL	LOC	EXP	HQ	SUB*	
					FSUB	BSUB
%BUY NAT	53%	56%	48%	67%	50%	55%
%DEMB NAT	38%	39%	29%	57%	42%	34%
%EMB NAT	35%	42%	34%	40%	27%	41%
%BUY INAT	57%	39%	43%	80%	76%	66%
%DEMB INAT	54%	37%	40%	77%	73%	62%
%EMB INAT	20%	11%	12%	33%	29%	31%

* Because our sample consists of firms located in Belgium, we need to distinguish between foreign and Belgian subsidiaries in order to disentangle the national versus international elements of the innovation strategy without exaggerating the national transactions of Belgian subsidiaries, which might just reflect transfers between headquarters and their Belgian subsidiaries, or, the international transactions of foreign subsidiaries, which might also reflect transfers between foreign headquarters and their subsidiaries located in Belgium.

TABLE 6: National and International Technology Sale						
	TOTAL	LOC	EXP	HQ	SUB	
					FSUB	BSUB
%SELL NAT	17%	18%	11%	13%	17%	31%
%SELL DEMB NAT	15%	16%	8%	13%	15%	31%
%SELL EMB NAT	8%	9%	8%	10%	6%	14%
%SELL INAT	39%	17%	25%	77%	56%	69%
%SELL DEMB INAT	37%	16%	23%	73%	55%	62%
%SELL EMB INAT	22%	9%	10%	47%	32%	55%

TABLE 7: National and International Cooperation						
	TOTAL	**LOC**	**EXP**	**HQ**	**SUB**	
					FSUB	**BSUB**
%COOP NAT	**36%**	**13%**	**30%**	**57%**	**53%**	**55%**
% COOP NAT link	26%	11%	22%	50%	35%	45%
% COOP NAT science	21%	8%	16%	47%	28%	38%
% COOP NAT comp	6%	3%	9%	13%	6%	14%
% COOP NAT intgr				37%	35%	38%
%COOP INAT	**32%**	**11%**	**20%**	**60%**	**49%**	**52%**
% COOPINAT link	14%	6%	10%	33%	19%	17%
% COOPINAT science	18%	7%	15%	37%	24%	38%
% COOPINAT comp	2%	1%	2%	7%	2%	7%
% COOPINAT intgr				40%	27%	31%

Figure 2: Typology of Foreign Subsidiaries



		Transfers received from affiliated: NO	Transfers received from affiliated: YES
Transfer generated to affiliated	NO	INDEPENDENT 31% (50)	ADAPTING 9% (15)
	YES	SOURCING 20% (32)	INTEGRATED 39% (63)

TABLE 8: National and International Innovation Strategies of Foreign Subsidiaries

	Independent	Adapting	Sourcing	Integrated	Total
% BUY NAT	46%	33%	53%	56%	50%
% BUY INAT	56%	87%*	78%	86%*	75%
% SELL NAT	4%	7%	28%	25%	18%
% SELL INAT	26%	27%	72%*	84%*	58%
% COOP ext NAT	36%	53%	53%	60%	51%
% COOP ext INAT	24%	40%	44%	54%	41%

The Chi-squared independence tests are significant for all row variables at the 1% level.
* Since the data do not allow to disentangle internal versus external BUY and SELL, these percentages are already high from internal BUY and SELL by the definition of the categories.